



Hemi-Hamate Arthroplasty in Old Neglected Proximal Interphalangeal Joint Fracture Dislocations

Ramesh Chandra Maharaj¹, Nihar Ranjan Mishra², Dillip Kumar Chand³

Assistant professor¹, Junior resident², Senior resident³

Department of Orthopaedics Surgery

S.C.B. Medical College and Hospital, Cuttack

Corresponding Author: Dillip Kumar Chand, Senior resident, Department of Orthopaedics Surgery, S.C.B. Medical College and Hospital, Cuttack

Type of Publication: Original Research Paper

Conflicts of Interest: Nil

Abstract

Background: Proximal inter-phalangeal joint injury is commonly seen in athletes & manual labourers. Being an articular fracture, it is prone for stiffness if neglected. In case of old fractures, hemi hamate arthroplasty is a well-established method.

Materials and Methods: Hemi-hamate arthroplasty procedure was used in the reconstruction in ten cases of old PIP Joint injury of the finger in a period of 2 years. 7 of them were treated inadequately else-where. All patients with atleast palmar lip or pilon fracture with >30% articular surface involvement were taken for the procedure.

Results: There was complete restoration of pre-injury movement in about 80% cases. There were 2 cases of graft non union which were managed successfully. No major donor site morbidity was reported except terminal pain on forced grip.

Conclusions: Hemi-hamate arthroplasty is reliable method in the treatment of old neglected PIP joint fracture dislocations. Key words: Hemi-hamate arthroplasty (HHA), old proximal inter-phalangeal joint (PIPJ) injury, Shot gunning

Introduction

Proximal inter-phalangeal joint fracture is an unsolved entity in hand surgery. There may be several issues to support this fact. First of all, it is the most commonly injured joint in the hand & the fact that these fractures occur most often following an axial impact on an extended finger, makes it a more substantial problem in a cricket loving & developing country like India where majority of population work as manual labourers.[1,4] But these are often overlooked or dismissed as nothing more than a “jammed” or sprained finger by coach or emergency physician. Graveness of the situation adds if the patient “self-treats” the injury considering it to be a minor trauma.[2] Both of these may lead to permanent stiffness due to unnecessarily long immobilization (if inadequately treated) or deformity (if neglected). This bicondylar joint has extreme flexibility and stability throughout its arc of motion, which are difficult to replicate after the joint has experienced injury or degenerative changes. [6] Stability and joint congruity are the most important factors in treatment of PIP joint fracture dislocations.[7] PIP joint is basically a synovial joint & functionally a hinge joint in nature. Its stability is well maintained by 2 anatomical

factors. The base of the middle phalanx carries a facet that is divided by a central ridge into two concavities. The head of the proximal phalanx is correspondingly trochlea-shaped, with the facets on the distal and flexor surfaces.[9] Secondly, capsulo-ligamentous structures of the PIPJ consisting of the collateral ligaments, the accessory collateral ligaments, the volar plate, the capsule and the central slip of the extensor mechanism are arranged in a box-like configuration that aids to its stability. This articular congruence & soft tissue envelope around the joint affords intrinsic stability to the joint, especially in an axially-loaded finger. [11]First introduced by Hastings et al, Hemi-hamate arthroplasty is the most recently developed technique & well established technique for reconstructing the volar buttress in old & in acute unstable proximal interphalangeal joint fracture dislocation.[17]This method is based on the fact that articular surface contour of the volar base of the middle phalanx resembles the dorsal hamate at the point where it articulates with the bases of the fourth and fifth metacarpals. The aim of this study is to evaluate the efficacy of hemi hamate arthroplasty in neglected old unstable proximal interphalangeal joint fracture dislocation.

Materials & Methods

We present ten cases operated in Dept. of Orthopaedics, S.C.B. Medical college, Cuttack during the period of June 2016 to May 2018, with old unstable palmar lip fractures of middle phalanx with dorsal dislocation or subluxation of the joint. All cases were operated with hemi hamate arthroplasty after proper consent & all necessary investigations.

Inclusion criteria

All old (>3 weeks) cases of unstable (at least 30% articular surface involvement) proximal inter-phalangeal

fracture (palmar lip/pilon) dislocation irrespective of degree of comminution & previous treatment.

Exclusion criteria

1. Dorsal lip fracture
2. Stable fracture dislocation (<30% articular surface involvement)
3. Patients with diaphyseal fracture extension

Surgical technique

General anaesthesia or regional block patient was administered. Patient was positioned supine & hand was supported by a hand table. Tourniquet was applied above elbow. After painting & proper draping, Bruner's incision was given. Radial & Ulnar neurovascular bundle was dissected. Flexor sheath was entered through A3 pulley. Volar plate was then dissected out from distal attachment & joint was shot-gunned. Fracture site was refreshed with oscillating saw & 2.4 mm osteotome as box/trapezoid shape. Longitudinal incision is made over the fourth and fifth carpo-metacarpal (CMC) joints. Fourth and fifth CMC joints are exposed & Graft was harvested from hamate including the articular cartilage from 4th/5th metacarpal joints. Then the graft was shaped & fixed with 1.5/2 mm screw or 1/1.25 mm K-wire. The volar plate was repaired subsequently. Lastly A3 pulley was repaired underneath flexor tendon to augment volar plate & prevent future adhesion of flexor tendon.

Post operative care & rehabilitation

Postoperatively hand was immobilised with below elbow POP cast holding the wrist in 30° of dorsiflexion, with the metacarpophalangeal joints in 70 degree flexion and the interphalangeal joints in full extension. After removal of stitches, immobilisation was continued for the first 3 weeks. Passive or active assisted flexion of fingers started after 3 weeks. Active flexion & extension of fingers allowed after 6 weeks (after removal of K-wire when

applied for fixation). Dorsal block splint was given for next 6 weeks.

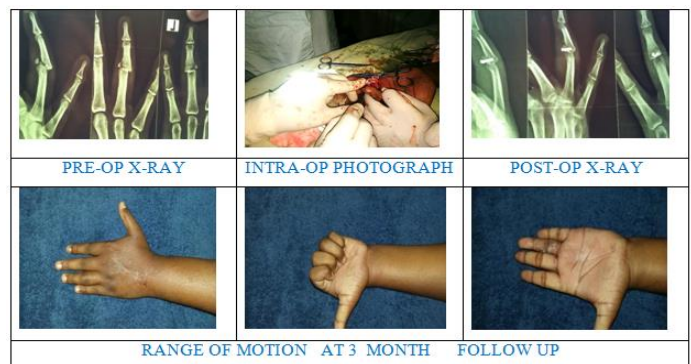
Result

Case no.	Injured hand	Injured finger	Age/ Gender	Delay (months)	Follow up (years)	Injury	Fixed with	Pain/ Complication	Rom (6 month follow up)
1.	Rt	Ring	M/43	2	2	sports injury	Screw	Terminal ROM Painful at PIP	0-95
2.	Lt	Ring	M/35	3.5	0.5	House Hold injury	K-Wire	Graft non-union	0-100
3.	Rt	Middle	M/27	1	2	RTA	Screw	None	0-100
4.	Rt	Ring	M/57	2	2	House hold injury	Screw	Hard-ware prominence & terminal pain at forced grip	0-90
5.	Rt	Index	M/45	2	2	Sports injury	K-wire	Broadening of PIPJ, Hardware prominence	0-100
6.	Lt	Middle	M/43	1.5	2	House hold injury	Screw	None	0-100
7.	Rt	Ring	F/38	3	2	House hold injury	K-wire	Graft Non-union	0-85
8.	Lt	Ring	F/60	2	2	House Hold injury	Screw	Broadening of PIP, terminal ROM painful at PIP	0-100
9.	Rt	Ring	M/37	1	1.5	RTA	Screw	Painful grip	0-95
10.	Rt	Little	F/45	2	2	RTA	K-wire	PIP Broadening	0-100

There was a mean delay of 8 weeks (4wks to 14 wks) between the injury and presentation to our OPD. All patients who presented with dorsal subluxation of PIP joint with volar lip fracture with >30% articular surface involvement were included in the study. Males are more commonly involved than females (6:4). Average age of presentation was 43 yrs. Most common cause of injury was house hold injuries followed by RTA. Ring finger was the most commonly involved finger & dominant hand was most commonly injured. 8 of them received previous treatment (3 were treated with buddy strapping, 2 with below elbow POP plaster cast & 2 with k wire fixation) else-where. The mean period of follow-up was 20 months. The average range of motion of the PIP joint before operation was 10°. Stiffness of the PIP joint was the chief complaint in majority of patients. Other major complains were persistent pain & instability. Hemi hamate arthroplasty was done in all cases. In 4 patients graft was fixed with 1 mm k wire & with 1.5 mm screw in 6 patients. The average flexion of the PIP joint at final follow-up was up to 90° (70°-100°). Proper reduction and congruency of the joint was noted on final true antero-posterior and true lateral radiograph of the digit. At final evaluation, no instability of the joints was observed in any of the cases. Other than the immediate postoperative pain,

some patients had terminal pain during mobilisation or movement of fingers after surgery which gradually improved with time over 3 months. Overall size of the graft used for reconstruction was about 10–15 mm in length (coronal plane), 8–10mm in breadth (sagittal plane), 5-10 mm in vertical height. There were 2 reports (with K-wire) of graft non-union. In 1 case revision was done with screw fixation & in other case additional cortico-cancellous bone graft from olecranon was added. Both united uneventfully over next 3 months. No incidence of resorption or degeneration was reported. 2 patients (with k wire) developed stiffness of PIP & DIP joint which completely improved later with regular supervised physiotherapy. There were no major complications at the donor site. There was no functional deficit in the 4th and 5th CMC joint following the procedure except terminal pain at power grip. We also observed hard-ware prominence in 2 cases & broadening of PIP Joint in 3 cases.

Case – 1



Case – 2



Discussion

Proximal inter-phalangeal fracture is considered as an enigma to the orthopaedic & hand surgeons owing to its complex anatomy, extensive classification system, wide range of treatment options available & devastating result if untreated or treated inadequately. Multiple systems of classification of this injury exist. We used the classification devised by Kiefhaber& Stern.[13] These are classified based on the direction of dislocation of the middle phalanx and their stability following reduction. The amount of articular surface involvement can often be used to predict stability. [15,16]In general, when dealing with finger fractures and dislocations, one must always remember that for every case of delayed or non-healing fracture, there are at least 100 permanently stiff fingers.[5]An extensive review of 96 injuries about the PIP joint by Benke and Stapleforth found a 30% poor recovery rate, as characterized by joint instability, poor function, pain or flexion deformities.[10]A commonly done mistake while dealing with PIP Joint injury is wrongly done x ray. Physician should advice for true AP & Lateral radiograph of the digit rather than AP, lateral or oblique view of the whole hand. With a true lateral view, there will be superimposition of the condyles of the head of the proximal phalanx that will allow detection of subtle joint abnormalities that may be otherwise overlooked.[8] PIP joint subluxation on lateral radiographs present a “V” sign. There are a number of treatment modalities of treatment options available for PIPJ injury. Mc Elfresh, Dobyns and O’Brien described the use of extension-block splinting as a treatment for dorsal fracture dislocation of the PIPJ.[28] Bunnell proposed the use of a trans articular wire, which was later used by Spray and Barton.[24,26,27] Ellis et al. reported 4 patients with fractures of 50% of the articular surface that regained 88° of PIP motion with external fixation.[20] Dionysian and Eaton reported their

long-term experiences with VPA. They reported a long term follow up of 17 patients for an average of 11.5 years.[24] However Hemi hamate arthroplasty is a time tasted method for old PIPJ injuries. In the initial description by Hastings et al. in 1999, 5 patients were reported to have recovered 77° of PIP motion and 81% of contralateral grip strength at 10 months post operatively.[17]Williams et al. subsequently published results of 13 reconstructions at a mean of 16 months.[19] Two patients had recurrent dorsal subluxation. Average ROM at the PIPJ was 85°, and 11 of 12 patients were very satisfied with the outcome. Calfee et al performed HHRA in 33 patients with a mix of acute and chronic dorsal fracture-dislocations. At a 4.5-year follow-up, mean PIPJ motion was 70°, with a mean DASH score of five. Notably, only patients with extensive comminution or pilon injuries had poor outcomes.[21]Afendras et al reported a mean arc of motion of 67° at a mean 4-year follow-up.[22] Two patients had severe arthritis based on radiographic criteria, with one having debilitating pain. The remaining seven patients in the study were satisfied with their outcomes.

	Number of cases	Follow-up (months)	VAS	PIPJ arc Mobility (degrees)	DASH	Articular Degeneration (%)	Grip strength (%)
Williams et al. (2003)	13	16	1.3	85	NA	NA	80
Afendras et al. (2010)	8	60	1	67	19	20	91
Calfee and Sommerkamp (2009)	22	54	1.4	70	5	43	95

(Clinical outcomes in published studies of hemi-hamate osteochondral autografting of unstable PIP joint fractures: VAS: Visual Analogue Score, DASH: Disability of Arm, Shoulder& Hand score)

The short-comings of this method as per our experience is the unavailability of a power burr of 4 mm size or a small osteotome of 2.4 mm size for back cutting of hamate which would be more helpful to harvest such a small size of osteo-chondral graft. Also, there is need of a special reduction clamp to maintain reduction and to prevent

crushing of the graft. Secondly, there was a long-term immobilisation (around 6 weeks) (specially in patients in whom graft was fixed with k wire) which led to stiffness in 2 patients which completely improved later with supervised physiotherapy. This case series may not be large enough to statistically analyse functional outcome of the method considering limited sample size. Lastly, it is a technically demanding procedure & needs experienced surgeon for good results.

Conclusion

Injuries about the PIP joint of the finger are commonly encountered in athletes, labourers & in road traffic accidents. This injury is usually neglected by both primary care physicians & patients which leads to significant morbidities like stiffness, instability, early osteo-arthritis, and residual deformities. Restoration of PIP motion should be the primary goal of treatment while dealing with old neglected fracture dislocations. Hemi hamate arthroplasty is an excellent method for unstable PIP Joint fractures with volar lip fracture. Its results in old neglected fracture-dislocations are promising in hands of experienced surgeons.

Reference

1. Green, DP. *Green's Operative Hand Surgery*. 6. Philadelphia, PA: Churchill Livingstone; 2005.
2. Elfar, MD and Tobias Mann, MD, MSc Fracture-dislocations of the Proximal Interphalangeal Joint. *J Am Acad Orthop Surg*. 2013 February ; 21(2): 88–98. doi:10.5435/JAAOS-21-02-88.
3. Strickland, JW., Steichen, JB. *American Society for Surgery of the Hand. Difficult Problems in Hand Surgery*. St. Louis, MO: Mosby; 1982. p. xiiip. 434
4. C. Y. Ng, C. W. Oliver; Fractures of the proximal interphalangeal joints of the fingers, *J Bone Joint Surg [Br]* 2009;91-B:705-12.

5. A Freiberg. Management of proximal interphalangeal joint injuries. *Can J Plast Surg* 2007; 15(4):199-203.
6. Minamikawa Y, Horii E, Amadio PC, Cooney WP, Linscheid RL, An KN. Stability and constraint of the proximal interphalangeal joint. *J Hand Surg Am*. 1993; 18: 198–204. [PubMed]
7. Najd Mazhar, F. Proximal interphalangeal joint fracture dislocation. *Shafa Ortho J*. 2013.1(2):29- 33.
8. Freiberg A, Pollard BA, Macdonald MR, Duncan MJ. Management of proximal interphalangeal joint injuries. *The Journal of Trauma: Injury, Infection, and Critical Care* 1999;46(3):523–8
9. Sinnatamby CS. *Last's anatomy regional and applied*. 10th ed. Edinburgh: Churchill Livingstone, 1999:35-105.
10. Benke GJ, Stapleforth PG. Injuries of the proximal interphalangeal joint of the fingers. *Hand* 1979;11:263.
11. Bowers WH, Wolf JW Jr, Nehil JL, Bittinger S. The proximal interphalangeal joint volar plate: I. An anatomical and biomechanical study. *J Hand Surg Am*. 1980; 5(1):79–88. [PubMed: 7365222]
12. Kuczynski K. The proximal interphalangeal joint: anatomy and causes of stiffness in the fingers. *J Bone Joint Surg Br* 1968;50:656–63
13. Kiefhaber TR, Stern PJ, Grood ES. Lateral stability of the proximal interphalangeal joint. *J Hand Surg [Am]* 1986; 11: 661-9.
14. Page SM, Stern PJ. Complications and range of motion following plate fixation of metacarpal and phalangeal fractures. *J Hand Surg [Am]* 1998; 23: 827-32.
15. Hastings H II, Carroll C IV. Treatment of closed articular fractures of the metacarpophalangeal and proximal interphalangeal joints. *Hand Clin*. 1988; 4(3):503–527. [PubMed: 3170661]

16. Krakauer JD, Stern PJ. Hinged device for fractures involving the proximal interphalangeal joint. *Clin OrthopRelat Res.* 1996; (327):29–37.
17. Hastings, H., Capo, J., Steinberg, B., Stern, P. Hemicondylar hamate replacement arthroplasty for proximal interphalangeal joint fracture/dislocations. Presented at the 54th Annual Meeting of the American Society for Surgery of the Hand; Boston, MA. September 2–4, 1999
18. R. P. Calfee, MD, T. R. Kiefhaber, MD, T. G. Sommerkamp, MD, P. J. Stern, MD; Hemi-Hamate Arthroplasty Provides Functional Reconstruction of Acute and Chronic Proximal Interphalangeal Fracture–Dislocations *J Hand Surg* 2009;34A:1232–1241.
19. Williams RM, Kiefhaber TR, Sommerkamp TG, Stern PJ. Treatment of unstable dorsal proximal interphalangeal fracture/dislocations using a hemi-hamate autograft. *J Hand Surg* 2003;28A: 856–865.
20. Ellis SJ, Cheng R, Prokopis P, Chetboun A, Wolfe SW, Athanasian EA, et al. Treatment of proximal interphalangeal dorsal fracture dislocation injuries with dynamic external fixation: a pins and rubber band system. *J Hand Surg* 2007; 32A:1242–1250.
21. Calfee RP, Kiefhaber TR, Sommerkamp TG, Stern PJ. Hemi-hamate arthroplasty provides functional reconstruction of acute and chronic proximal interphalangeal fracture-dislocations. *J Hand Surg Am.* 2009; 34(7):1232–1241. [PubMed: 19700071]
22. Afendras G, Abramo A, Mrkonjic A, Geijer M, Kopylov P, Tägil M. Hemi-hamate osteochondral transplantation in proximal interphalangeal dorsal fracture dislocations: A minimum 4 year follow-up in eight patients. *J Hand Surg Eur Vol.* 2010; 35(8):627–631. [PubMed: 20511322]
23. M. Burnier, T. Awada, F. Marin Braun, P. Rostoucher, M. Ninou and L. Erhard; Treatment of unstable proximal interphalangeal joint fractures with hemi-hamate osteochondral autografts, *The Journal of Hand Surgery (European Volume)* XXE(X)16sagepub.co.uk/journalsPermissions.navDOI:10.1177/1753193416671886
24. Dionysian E, Eaton RG. The long-term out-come of volar plate arthroplasty of the proximal interphalangeal joint. *J Hand Surg [Am].* 2000; 25:429-437.
25. Bunnell S. *Surgery of the hand.* Third ed. Philadelphia: J. B. Lippincott, 1956:808.
26. Spray P. Finger fracture-dislocation proximal at the interphalangeal joint. *J Tenn Med Assoc* 1966; 59:765-6.
27. Barton NJ. Fractures of the hand. *J Bone Joint Surg [Br]* 1984; 66-B: 159-67.
28. Mc Elfresh EC, Dobyns JH, O'Brien ET. Management of fracture-dislocation of the proximal interphalangeal joints by extension-block splinting. *J Bone Joint Surg [Am]* 1972;54-A:1705-11.
29. Pradeoth M. Korambayil Anto Francis: Hemi-hamate arthroplasty for pilon fractures of finger, *Indian J Plast Surg.* 2011 Sep-Dec; 44(3): 458–466. doi: 10.4103/0970-03